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14. An apparatus according to claim 12 wherein one of said first removal means and said second removal means is selected from the group consisting of electrically regenerated ion exchange apparatus, electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus and electrodiuresis apparatus and one of said first removal means and said second removal means is selected from the group consisting of reverse osmosis apparatus, nanofiltrative apparatus, chemically regenerated ion exchange apparatus, activated carbon apparatus and other sorbent apparatus.

REMARKS

Upon entry of the present amendments, claims 1-23 are pending. Applicant has amended claim 1 at the suggestion of the Examiner (and also claim 12) to remove recitation of "step (b)". Applicant has also amended claim 5 to remove recitation of an "oxidizing" agent. These amendments are made to correct claim informalities, not in response to a claim rejection. Applicant thanks the Examiner for these suggestions. Also, Applicant has amended claims 1 and 14 to correct simple spelling errors.

Applicant has amended claims 1 and 12 to recite the oxidation and removal of "organic carbon compounds". This amendment is made to make clearer the operation of the claimed process and apparatus, and is not made in response to a claim rejection. Support for the amendments to the following claims can be found throughout the specification, and particularly on page 3, lines 24-31, which describe the oxidation of organic carbon compounds. No new matter has been added.

Attached hereto is a marked-up copy of the claims as amended, showing the changes made. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE". No new matter is added.

The Invention:

The invention is directed to an economic and efficient method and apparatus for removing from water both ionized and/or ionizable carbon compounds and non-ionized and/or non-ionizable carbon compounds. The elements of the invention include:

- (a) first removing from the water ionized and/or ionizable carbon compounds, some of which carbon compounds are susceptible to oxidative conversion to non-ionized and/or non-ionizable carbon compounds;
- (b) then converting non-ionized and/or non-ionizable compounds to ionized and/or ionizable compounds by oxidation; and
- (c) subsequently again removing from the water the ionized and/or ionizable carbon compounds.

The apparatus used in (a) and the apparatus used in (c) each belong to the group of electrical apparatuses including an electrically regenerated ion exchange apparatus; an electrodeionization apparatus; an electrodialysis apparatus; a filled cell electrodialysis apparatus; or an electrodiagnosis apparatus.

In particular embodiments, the apparatus used in (a) and the apparatus used in (c) each belong to the subgroup of reverse osmosis apparatus; nanofiltration apparatus; chemically regenerated ion exchange apparatus; activated carbon apparatus; or other sorbent apparatus.

It has been a long-sought goal of water treatment engineers to find economic and efficient methods to reduce total organic carbon ("TOC") in water to very low levels. The present invention is based upon the discovery of why prior art methods had not been both economic and efficient. The inventor found that the methods of oxidation in the prior art generally proceed by purification steps as follow:

	<u>Compound Removed</u>	<u>Compound Not Removed</u>
Very early step	Non-Ionized or Non-Ionizable	Ionized or Ionizable
Early step	Ionized or Ionizable	Non-Ionized or Non-Ionizable
Middle step	Non-Ionized or Non-Ionizable	Ionized or Ionizable
Later step	Ionized or Ionizable	Non-Ionized or Non-Ionizable
	Etc.	Etc.

By a prolonged, extensive, non-economic and non-efficient process using a prior art method; one could usually (but not always) arrive at carbon dioxide, carbonic acid, and/or bicarbonate.

What the inventor has recognized (and which had not been recognized before) is that that if ionized and/or ionizable organic compounds were not first removed from a water stream, then any subsequent oxidation step involving the water stream could convert these ionized and/or ionizable organic compounds to non-ionized and/or non-ionizable organic compounds. These

newly formed non-ionized and/or non-ionizable organic compounds would not then be removed by a subsequent removal step. This is because, even after a partial preliminary oxidation, a removal step will only remove that fraction of the organic compounds that are in an ionized/ionizable state.

The inventor, having recognized the problem, then solved the problem by (a) first removing ionized and/or ionizable compounds, so that they could not be converted to non-ionized and/or non-ionizable compounds; (b) then oxidizing the remaining non-ionized and/or non-ionizable compounds to ionized and/or ionizable compounds; and (c) subsequently removing the newly formed ionized and/or ionizable compounds.

The inventor also realized that it was not economic and not efficient to use non-regenerable mixed bed ion-exchangers in both steps of removing the ionized and/or ionizable compounds. Accordingly, the claimed invention recites the use of electrical apparatuses, which can more readily be regenerated.

Rejections Under 35 U.S.C. § 102

The Examiner has rejected claims 1, 3-4, 12, 14-16 and 18 as allegedly anticipated by U.S. Pat. No. 5,833,846 ("*Tanabe*"). Applicant respectfully traverses.

Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration. MPEP § 2131. "Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim." *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 221 USPQ 481, 485 (Fed. Cir. 1984); *see also, In re Bond*, 15 USPQ2d 1566 (Fed. Cir. 1990). "There must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention." *Scripps Clinic & Research Foundation v. Genentech Inc.*, 18 USPQ 2d 1001, 1010 (Fed. Cir. 1991). Here, one of skill in the art can readily recognize differences between *Tanabe* and the claimed invention. The steps of the claimed invention are not the same as the steps disclosed by *Tanabe*, particularly in the order of the steps of the claimed invention.

The Examiner refers to *Tanabe*, Fig. 1, elements 106, 108, and 109 (Office Action, pg. 2, para. 4). The arrangement of elements 106, 107, 108 and 109 is essentially the same as in all of Figs. 1, 2, 3, 4, 5, 6, and 7.

Applicant respectfully disagrees that *Tanabe*, Fig. 1, element 106 is equivalent to a first removal means for removing from the water ionized and/or ionizable carbon compounds, as recited in claims 1(a) and 12(a). Element 106 is "a non-regenerative type ion exchanger 106 containing a mixture of a strongly acidic cation exchange resin and strongly basic anion exchange resin to produce primary deionized water having a specific sensitivity of about 18 mΩ-cm." See, *Tanabe*, col. 3, lines 2 to 6. Such a "non-regenerative ion exchanger" containing such a mixture is not a member of the group of removal apparatuses recited in the pending claims 1, 3, 12, and 14, which are all electrical apparatuses.

Further, there is no explicit or implicit disclosure (or even a suggestion) in *Tanabe* that the water in element 106 has both ionized and/or ionizable carbon compounds and non-ionized and/or non-ionizable carbon compounds, as recited in the present claims.

Applicant also respectfully disagrees that *Tanabe*, Fig. 1, element 109 is a equivalent to a second removal means for removing from the water ionized and/or ionizable carbon compounds, as recited in claims 1(c) and 12(c). Moreover, element 109 is not member of the group as claimed in claims 1, 3, 12, and 14. Element 109 is a "cartridge polisher [that] removes organic acids and carbonic acid, as well as other impurities contained to a small extent." to *Tanabe*, col. 2, lines 20-22.

In *Tanabe*, Figs. 3 and 6, element 104 is replaced by EDI. In *Tanabe*, Figs. 4 and 7, element 104 is replaced by distillation. None of these substitutions are equivalent to a first removal means for removing from the water ionized and/or ionizable carbon compounds, as recited in claims 1(a) and 12(a).

The Examiner also refers to *Tanabe*, col. 2, lines 23-68, and further to col. 3, lines 1-31. *Tanabe*, col. 2, lines 23-68 describes the pretreatment/primary treatment elements 106, 108, and 109, as discussed above. *Tanabe*, col. 2, lines 56-58, discloses that a "first reverse osmosis membrane unit 103 [is] designed to eliminate ionic impurities and non-ionic organic substances", clearly meaning that the feed to element 106 does not have the non-ionic organic substances recited in the present claims.

Tanabe, col. 3, lines 1 to 31 further describe the elements of the *Tanabe* apparatus, but do not describe structures equivalent to the elements of the claimed method and apparatus. Accordingly, *Tanabe* does not disclose each and every element of the claimed invention, and

thus cannot anticipate the claimed invention. Applicant respectfully requests that his rejection be withdrawn.

Rejections Under 35 U.S.C. § 103

The Examiner has rejected claims 2, 5, 8, 13 and 17 as allegedly obvious in view of a combination of *Tanabe* and U.S. Pat. No. 5,116,509 ("*White*"). Applicant respectfully traverses.

The Examiner has not set forth a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, there must be some suggestion or motivation to modify the reference or to combine reference teachings; and the prior art references must teach or suggest all the claim limitations. MPEP § 2143.

First, there is no motivation here to combine *Tanabe* and *White*. There is nothing in the teachings of *Tanabe* (which pertains to improvements on boron removal) that would teach or suggest combining this reference with the UV step of *White*. *Tanabe* does not recognize the problem that is solved by the invention as described above, nor does *Tanabe* provide the solution as recited in the claims. Nowhere does *Tanabe* teach or suggest processing a first stream of water with a first removal apparatus for removing ionized and/or ionizable carbon compounds, wherein at least some of such compounds are susceptible to conversion to non-ionized and/or non-ionizable carbon compounds by a subsequent agent for converting non-ionized and/or non-ionizable carbon compounds to ionized and/or ionizable carbon compounds.

Likewise, *White* does not recognize or attempt to solve the problem addressed by the inventors. The Examiner cites *White* for the use an applied UV wavelength of 184.9 nanometers to effect oxidation of organics in water in the removal of TOC. However, the addition of an applied UV wavelength of 184.9 nanometers with the teachings of *Tanabe* does not result in the claimed invention. The differences between the use of UV light by *White* and the use of UV light in the claimed invention is discussed in the application, pp. 2-3.

U.S. Patent No. 5,116,509 discloses use of an ultraviolet (UV) treatment step for deionized tap water prior to EDI treatment, but fails to teach or to suggest a system which processes such tap water initially containing non-ionized or non-ionizable carbon compounds in addition to ionic or ionizable organic species. "Substantially complete removal" of total organic carbon (TOC) is purported to have been obtained using the system of U.S. Pat. No. 5,116,509. The patent teaches that following an initial deionization, organic species may be added to the deionized tap water and applied UV may break down the added organic species into smaller

molecules, some of which are ionic and/or ionizable, allowing subsequent EDI to achieve the claimed TOC reduction. When some part of the added organic species is already in ionic and/or ionizable form, the claims for such a process may not be totally true, however. Although UV may convert non-ionizable organic species into ionic and/or ionizable organic species, UV may also convert ionic and/or ionizable organic species into non-ionizable organic species. If a significant amount of the organic species is in ionic and/or ionizable forms, application of UV may increase the concentration of non-ionizable organic species in the subsequent EDI feed, and may result in a lower organic carbon reduction than without UV. Further, the ionic or ionizable organic species may absorb UV further reducing UV available for converting non-ionizable organic species into ionic or ionizable organic species.

By contrast, the claimed use of the UV light in the present is in conjunction with the first and second removal apparatuses, a parts of the invention as a whole, as described in the specification, pp. 3-4:

In accordance with the invention, such first one or more deionization stages remove the ionic and/or ionizable inorganic and organic carbon species. The effluent from such first deionization stages is exposed to organic carbon bond-breaking agents, such as UV (preferably 184.9 nm wavelength or less) including catalyzed UV and/or other oxidizing agents (e.g., oxygen, ozone, singlet oxygen, hydrogen peroxide, hydroxide radical, means to produce singlet oxygen or hydroxide radical or combinations thereof). These agents break down organic carbon compounds from such first deionization stages. With the subject invention, it is not necessary to provide a level of UV energy sufficient to break down organic components all the way to H₂O and CO₂, but rather it is sufficient to break down those components into compounds which may be removed in subsequent removal stage(s).

(emphasis added). Accordingly, one would not combine *White* to achieve the UV step of the invention, since the purposes of the UV of *White* and the UV of the present invention are intended to accomplish different functions in the two different methods, each taken as a whole.

Second, the combination of *Tanabe* and *White* does not teach or suggest all the claim limitations. The failure of *Tanabe* to teach a first and second removal apparatus is discussed above. *White* does not cure the failings of *Tanabe*.

The Examiner cites *White* (Office Action, page 3, para. 6) as disclosing the treatment of water by the combination of ultraviolet light (UV) treatment and ion exchange deionization (*White*, col. 1, line 3) and recirculating the water between the two steps a plurality of times. However, at col. 2, line 3 *et seq.*, *White* recites that according to their invention: "Water is purified continuously to effect ion removal and essentially complete removal of TOC [total organic carbon] on a one pass process by exposure to ultraviolet radiation to effect oxidation of

organics followed by electrodeionization in a particular manner" (emphasis added). *White* does not precede the UV oxidation step by a step for removing ionized and/or ionizable organics, and therefore does not recognize or solve the problem solved by the present invention.

The Examiner also alleges that *White* discloses the combination of the first and second apparatus in the second embodiment, electrodeionization-ion exchange (in *White*, col. 3, lines 26-37). Applicant respectfully disagrees. The cited recitation does not refer to two apparatuses, but rather to a single electrodeionization apparatus that inherently contains ion exchange membranes.

Moreover, nowhere in col. 2, lines 1-26 or 59-68, col. 3 or col. 4, lines 1-66, does *White* disclose the combination of the electro-deionization treatment with other processes, *e.g.*, reverse osmosis, ultrafiltration, or ion exchange.

The steps of the claimed invention are not the same as the steps disclosed by *Tanabe*, particularly in the order of the steps of the claimed invention, and that the combination with *White* does not cure the failure of *Tanabe* to teach the particular steps of the method. Accordingly, the combination of *Tanabe* and *White* does not render obvious the claimed invention. Applicant respectfully requests that his rejection be withdrawn.

The Examiner has also rejected claims 1-4, 6-7, 12-16, and 18 as allegedly obvious in view of a combination of U.S. Pat. No. 4,863,608 ("*Kawai*") and U.S. Pat. No. 4,676,908 ("*Ciepiela*"). Applicant respectfully traverses.

Kawai at col. 1, line 39, recites various processes that had been used for the preparation of ultrapure water, giving as typical processes reverse osmosis, adsorption on ion exchange resin, ultrafiltration and "'UV oxidation' so-called" (*sic*; but see below), which are "adopted separately or usually in any appropriate combination thereof for a particular case". *Kawai*, col. 1, line 44, states that the above process or processes are in any case combined with pre-treatment steps such as conventional filter means. *Kawai* do not give as appropriate combination:

- (a) first removing from the water ionized (and/or ionizable) carbon compounds, some of which compounds are susceptible to conversion by oxidation to non-ionized (and/or non-ionizable) carbon compounds;
- (b) then converting non-ionized (and/or non-ionizable) compounds to ionized (and/or ionizable) compounds;

- (c) subsequently again removing from the water ionized (and/or ionizable) carbon compounds.

Indeed, at col. 1, line 55, *Kawai* state that

One of the most typical processes ... practiced in the prior art for preparation of ultrapure water ... comprises the steps of prefiltration ... for removal of solid particulate contaminants ... reverse osmosis for removal of at least 99% of solid particulate contaminants, at least about 90% of ionic contaminants and at least about 80% of organic contaminants ... sterilization with UV radiation ... ion exchange treatment for removal of ionic contaminants to a level being substantially complete; and ultrafiltration for the removal of residual trace contaminants ...

(emphasis added). Importantly, the "UV sterilization" at col. 1, line 65-66 is not "UV oxidation".

Indeed, *Kawai* state at col. 3, line 31:

In this connection, it is to be added by way of reference that a simple UV irradiation which is a well-known step to be adopted during the preparation of ultra pure water is for the purpose of sterilization or destruction of microorganisms as, for example, disclosed in T.L. Faylor et al.'s U.S. Pat. No. 3,870,033. Thus UV sterilization is conventionally effected by irradiation from a low-pressure mercury lamp, i.e., by UV light mainly of 2537 Å [253.7 nm]. Clearly, under such conditions, there occurs no oxidation of organic materials included in TOC content at all"

(emphasis added).

Indeed, *Kawai* teaches away from the claimed invention. At col. 2, lines 3-11, *Kawai* states that:

it is of course customary in the art to make some change of the sequence of steps or replacement, addition, or other modification of steps ... For example, a UV oxidation step ... will usually and advantageously be inserted after the prefiltration step.

(emphasis added). In other words, the UV step is before the first removal of ionized and/or ionizable carbon compounds.

It is not surprising that *Kawai* should teach away from the present invention, because, as a reading of the patent shows, *Kawai* was not aware of the problem discovered and solved by the present invention. Instead, *Kawai* uses an uneconomic process using very expensive noble metal catalysts and an uneconomic amount of UV irradiation to convert organics entirely to carbon dioxide and water.

The combination of *Kawai* with *Ciepiela* does not correct the deficiencies of *Kawai* in teaching the claimed invention. In general, *Ciepiela* does not address the problem identified and

solved by the inventors. Specifically, *Ciepiela* does not teach or suggest the limitations missing in *Kawai*.

Ciepiela pertains to the treatment of

Waste water streams from the steam-extraction of heavy oils to remove organic contaminants, suspended solids and mineral contaminants, so as to produce a purified water stream of a quality suitable for reuse in steam production ... organic contaminants are removed by activated carbon, and mineral contaminants are removed by electrodialysis or reverse osmosis and ion exchange.

Ciepiela, Abstract. *Ciepiela*, col. 8, lines 49-54 does not suggest a combination with the *Kawai* process. Such lines read only that:

The effluent from the [existing hot] lime softeners may be processed by a sequence of activated carbon adsorption, electrodialysis or reverse osmosis, and ion exchange. In this way, a higher quality water may be produced than the existing water softeners can produce, leading to a decreased requirement for a boiler blow-down.

Also, in *Ciepiela*, Fig. 1, there is no disclosure of any UV treatment, whether for sterilization or for oxidation. Thus, *Ciepiela* does not oxidize organics and does not correct the deficiencies of *Kawai* to teach this limitation.

Moreover, *Ciepiela* does not correct the failure of *Kawai* to teach the first and second removal apparatuses. The Examiner alleges that "Reference '908 [*Ciepiela*] discloses reverse osmosis as equivalent to reverse osmosis for the purpose of removing carbonate or ionic species in water to be treated (column 5, lines 26-36, column 6, lines 37-42)." Office Action, page 4, para. 7. However, electrodialysis is not equivalent to reverse osmosis plus ion exchange.

Ciepiela, col. 5, lines 27-36 pertain to "fouling" of ion exchange membranes in electrodialysis by precipitation of "soluble" [sic] salts, such as calcium carbonate, organic matter and metal oxides, and to the provisions for periodic cleaning of the membranes to remove the foulants. *Ciepiela*, col. 6, lines 37-40 recites that the "electrodialysis unit 46 and/or the ion exchange unit 64 may be replaced by a reverse osmosis (RO) unit, if desired, to effect the demineralization of the waste water in line 44 and/or line 62". That the electrodialysis unit and/or the ion exchange unit may be replaced by a reverse osmosis unit for the purposes of the *Ciepiela* process does not imply that the three processes are equivalent to each other for the purposes of the claimed invention.

The combination of *Kawai* and *Ciepiela* does not render obvious the claimed invention. Applicant respectfully requests that his rejection be withdrawn.

The Examiner has rejected claims 1-6, 10, 12-19, and 21-23 as allegedly obvious in view of a combination of Japanese patent applications JP 61101292 ("*Kurita Water/Masabumi*") and 53149873 ("*Kurita Water/Tsutomi*") or U.S. Pat. No. 5,118,422 ("*Cooper*"). Applicant respectfully traverses.

The Examiner alleges that "'292 [*Kurita Water/Masabumi*] discloses the apparatus and process of removing organic substances from water, the process includes radiation, ion exchange, second irradiation, and second ion exchange, therefore, the combination of claim 2 in the same apparatus is disclosed." Applicant respectfully disagrees. Claim 2 depends from claim 1 and recites that the first removal apparatus is the same as the second removal apparatus, that is:

- (a) processing a first stream of the water with a first removal apparatus for removing from the water ionized and/or ionizable carbon compounds, to produce a first product stream containing a smaller concentration of ionized and/or ionizable carbon compounds than the first stream;
- (b) contacting the first product stream with an agent for converting non-ionized and/or non-ionizable carbon compounds into ionized and/or ionizable carbon compounds to form a second product stream containing a smaller concentration of non-ionized and/or non-ionizable carbon compounds and a larger concentration of ionized and/or ionizable carbon compounds than the first product stream;
- (c) processing the second product stream with a first removal apparatus, etc.

Also, the first and second removal apparatus is selected from electrically regenerated ion exchange apparatus; electrodeionization apparatus; electrodialysis apparatus; filled cell electrodialysis apparatus; or electrodialysis apparatus.

Kurita Water/Masabumi does not disclose such a process and apparatus. Ion exchange is not a member of the above group, all of which are electrical processes. *Kurita Water/Masabumi* does not disclose any member of the listed group or suggest that ion exchange is equivalent to any member of the group for the purposes of the claimed invention. Thus, *Kurita Water/Masabumi* does not recognize and solve the problem discovered and solved by the present invention, and does not provide an economic solution to the problem.

Kurita Water/Tsutomi does not supply the aspects of the invention as a whole that are missing from *Kurita Water/Masabumi*. As described above, the listed removal apparatuses are electrical devices. Distillation and reverse osmosis are not equivalent are not equivalent to the first and second removal apparatus as recited in the claims.

Likewise, *Cooper* does not supply the aspects of the invention as a whole that are missing from *Kurita Water/Masabumi*. The process of *Cooper* is described at col. 11, line 43 *et seq.*:

The waste-water distillate/RO permeate will be transferred ... to the reactor loop where the photocatalyst and oxygen will be added ... The total amount of oxygen added ... will be enough to ensure complete and rapid oxidation of organics ... The reaction mixture will be reincubated ... through the photocatalytic reactor loop to effect purification ... A second ... pump then circulates the slurry [of water and photocatalyst particles] through the cross-flow filter [having a pore size of 0.2 micrometers, col. 11, line 3] to effect separation [of water and photocatalytic slurry]. The permeate (pure water) will be collected in a ... reservoir ... while the [photocatalytic] slurry retentate ... is then transferred ... to the [photocatalytic] reactor, completing the cycle.”

The point of the *Cooper* process recited above is that the process does not use a second apparatus for removing ionized and/or ionizable carbon compounds from the product stream of UV oxidation. Distillation and reverse osmosis are not equivalent are not equivalent to the second removal apparatus as recited in the claims. Instead, the *Cooper* process oxidizes organics completely to carbon dioxide.

The *Cooper* process of complete oxidation is uneconomic, as compared to the claimed invention. *Cooper* shows at col. 12, lines 27-34, that the energy consumption for the UV oxidation is 225 watt-hours for 4.5 liters of product, *i.e.*, 50 watt-hours per liter, 50 kilowatt-hours per cubic meter and 189 kilowatt-hour per thousand U.S. gallons, an unacceptably high amount of energy. In contrast, the present inventor, having discovered the nature of the problem of oxidation of organics in water, has invented an economic solution to the problem.

In summary, the combination of *Kurita Water/Masabumi* and *Kurita Water/Tsutomi* or *Cooper* does not render obvious the claimed invention. Applicant respectfully requests that his rejection be withdrawn.

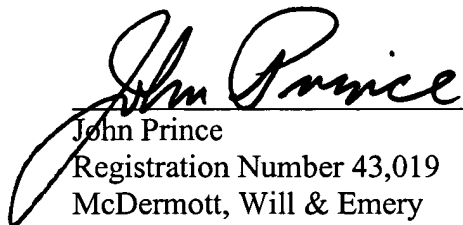
In re Application of: Li Zhang
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CONCLUSION

On the basis of the foregoing amendments, the Applicant respectfully submits that the pending claims are in condition for allowance. If there are any questions regarding these amendments and remarks, the Examiner is encouraged to contact the undersigned at the telephone number provided below.

Date: September 14, 2001

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES

In the claims:

1. (Amended) A method for removing both (i) ionizable and/or ionized organic carbon compounds and (ii) non-ionized and/or non-ionizable organic carbon compounds from water comprising the steps of:
 - (a) processing a first stream of the water with a first removal apparatus for removing from the water ionized and/or ionizable organic carbon compounds, wherein at least some of such ionized and/or ionizable organic carbon compounds are susceptible to conversion to non-ionized and/or non-ionizable organic carbon compounds by ~~step (b) below~~ an agent for converting non-ionized and/or non-ionizable organic compounds into ionized and/or ionizable organic compounds, to produce a first product stream containing a smaller concentration of ionized and/or ionizable organic carbon compounds than the first stream;
 - (b) contacting the first product stream with an agent for converting non-ionized and/or non-ionizable organic carbon compounds into ionized and/or ionizable organic carbon compounds at a time and a temperature sufficient to form a second product stream containing a smaller concentration of non-ionized and/or non-ionizable organic carbon compounds and a larger concentration of ionized and/or ionizable organic carbon compounds than the first product stream;
 - (c) processing the second product stream with a second removal apparatus for removing ionized and/or ionizable organic carbon compounds from the water to form a third product stream containing a smaller concentration of ionized and/or ionizable organic carbon compounds and non-ionized and/or non-ionizable organic carbon compounds than the first stream; and
 - (d) recovering the third product stream from step (c), wherein at least one of said first removal apparatus and said second removal apparatus is selected from the group consisting of electrically regenerated ion exchange apparatus, electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus and electrodiuresis apparatus.

2. A method according to claim 1 wherein the first removal apparatus comprises the second removal apparatus.
3. A method according to claim 1 wherein one of said first removal apparatus and said second removal apparatus is selected from the group consisting of electrically regenerated ion exchange apparatus, electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus, filled cell electrodialysis apparatus and electrodiuresis apparatus, and one of said first removal apparatus and said second removal apparatus is selected from the group consisting of reverse osmosis apparatus, nanofiltration apparatus, chemically regenerated ion exchange apparatus, activated carbon apparatus and other sorbent apparatus.
4. A method according to claim 1, wherein the agent is selected from the group consisting of an oxygen, ozone, singlet oxygen, hydrogen peroxide, chemical oxidizing agent, electrolytic oxidizing agent, electrochemical oxidizing agent, catalytic oxidizing agent, thermal oxidizing agent, and radiation and combinations thereof.
5. (Amended) A method according to claim 4 wherein the ~~oxidizing~~ agent comprises radiation characterized by wavelengths of about 184.9 nm.
6. A method according to claim 1 wherein the agent comprises ultraviolet radiation.
7. A method according to claim 6 wherein the agent further comprises hydrogen peroxide.
8. A method according to claim 6 wherein the agent further comprises a catalyst.
9. A method according to claim 6 wherein the agent further comprises a catalyst.
10. A method according to claim 9 wherein the catalyst comprises titanium oxide.

11. A method according to claim 1 wherein the agent comprises ozone and hydrogen peroxide.
12. (Amended) An apparatus for removing both (i) ionizable and/or ionized organic carbon compounds and (ii) non-ionized and/or non-ionizable organic carbon compounds from water comprising:
 - (a) a first removal means for removing from the water ionized and/or ionizable organic carbon compounds, wherein at least some of such ionized and/or ionizable organic carbon compounds are susceptible to conversion to non-ionized and/or non-ionizable organic carbon compounds by a conversion means ~~(b) below for~~ converting non-ionized and/or non-ionizable organic carbon compounds into ionized and/or ionizable organic carbon compounds, to produce a first product stream containing a smaller concentration of ionized and/or ionizable organic carbon compounds than the first stream;
 - (b) a conversion means for converting non-ionized and/or non-ionizable organic carbon compounds into ionized and/or ionizable organic carbon compounds at a time and a temperature sufficient to form a second product stream containing a smaller concentration of non-ionized and/or non-ionizable organic carbon compounds and a larger concentration of ionized and/or ionizable organic carbon compounds than the first product stream;
 - (c) a second removal means for removing ionized and/or ionizable carbon compounds from the water to form a third product stream containing a smaller concentration of ionized and/or ionizable organic carbon compounds and non-ionized and/or non-ionizable organic carbon compounds than the first stream; and
 - (d) a recovery means for recovering the third product stream;wherein at least one of said first removal means and said second removal means is selected from the group consisting of electrically regenerated ion exchange apparatus, electrodeionization apparatus, electrodialysis apparatus, ~~filtered~~ filled cell electrodialysis apparatus and electrodiagnosis apparatus.

13. An apparatus according to claim 12 wherein the first removal means comprises the second removal means.
14. (Amended) An apparatus according to claim 12 wherein one of said first removal means and said second removal means is selected from the group consisting of electrically regenerated ion exchange apparatus, electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus and electrodiaresis apparatus and one of said first removal means and said second removal means is selected from the group consisting of reverse osmosis apparatus, ~~nonfiltrative~~ nanofiltrative apparatus, chemically regenerated ion exchange apparatus, activated carbon apparatus and other sorbent apparatus.
15. An apparatus according to claim 12 wherein the conversion means comprises contact means for contacting the first product stream with an agent.
16. An apparatus according to claim 15 wherein the agent is selected from the group consisting of a oxygen, ozone, singlet oxygen, hydrogen peroxide, chemical oxidizing agent, electrolytic oxidizing agent, electrochemical oxidizing agent, catalytic oxidizing agent, thermal oxidizing agent, and radiation.
17. An apparatus according to claim 16 wherein the oxidizing agent comprises radiation characterized by wavelengths of about 184.9 nm.
18. An apparatus according to claim 16 wherein the oxidizing agent comprises ultraviolet radiation.
19. An apparatus according to claim 18 wherein the agent further comprises hydrogen peroxide.
20. An apparatus according to claim 18 wherein the agent further comprises ozone.

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21. An apparatus according to claim 20 wherein the agent further comprises a catalyst.
22. An apparatus according to claim 16 wherein the catalyst comprises titanium oxide.
23. An apparatus according to claim 15 wherein the agent comprises ozone and hydrogen peroxide.